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USSR Report

ECONOMIC AFFAIRS

(FOUO 8/79)



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MANAGEMENT OF NATIONAL ECONOMIC PROGRAMS

Moscow VOPROSY EKONOMIKI in Russian No 6, Jun 79 pp 33-43

[Article by B. Mil'ner, L. Yevenko and V. Rapoport]

[Text] L. I. Brezhnev noted at the 25th CPSU Congress that "the time has come to improve methods for comprehensive solution of major nationwide intersector and regional problems. What we need are unified and centralized programs embracing all stages of the job--from project planning to actual execution. It is important that in every case there be specific agencies and specific people bearing the entire breadth of responsibility and coordinating all efforts that come under the particular program."

It is one of the principles organically inherent in the methodology of socialist economic planning to formulate goals and to concretize plans in the form of elaborate programs of production, organizational-and-technical and other measures. Indicators reflecting the final results of production-economic performance are an important component of the national economic plan. Central and regional economic management authorities and ministries and departments regularly compile programs of operations, assign tasks to those responsible for performing them, allocate resources, fix interrelated deadlines, define lines of communication in industrial cooperation, and so on.

The emphasis at present is being put on the interdepartmental and interorganizational character of special-purpose program approach in which an entire set of operations (research and development, design, planning, production in different industries, material and technical supply, staffing and information support, and delivery of the product and services to the point of final consumption, and so on) is regarded as a unified system and the point of departure is the final benefit in the production or nonproductive spheres regardless of departmental and sectoral subordination.

In a number of cases it proved to be easy to tie the special-purpose program orientation of national economic and sectorwide measures in with the existing structure of planning and economic organization. But not uncommonly the need arises to supplement the sectoral and regional economic plan with a special-purpose program grouping of the measures that have been planned and

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also to set apart the subdivisions participating in performance of projects under the program to form a separate system which is regarded as an independent entity to be managed. The distinguishing feature of the special-purpose program approach in the contemporary context is this unity of planning, organization, guidance and oversight of sets of goal-oriented measures.

The socialist economic system has built up a great deal of experience in drafting and performing large-scale comprehensive programs. Indeed Russia's first economic development plan--GOELRO [State Commission for Electrification of Russia]--was actually structured on the program principle. Later many other comprehensive programs were successfully carried out (construction of large-scale industrial projects, the conquest of space, the building of the atomic industry, development of education and health care, housing construction and the development of major regions). It is a peculiarity of the way their performance was organized that either a specialized institution was created (a ministry, committee or main administration) that was allocated the resources and bore full responsibility for achievement of the goals of the program, or one of the existing organs planned the new program and monitored its fulfillment.

The organizational problem is now being posed in a different way. Contemporary comprehensive programs often do not fit within the sphere of activity of any individual ministries and departments or regional administrative agencies taken separately. Their performance, which requires efficient coordination and supervision of the interrelated activity of a large number of production, scientific and economic organizations of differing departmental subordination, is furthered if a new organization is set up.

The organizational aspects of national economic programs comprise a separate subject of inquiry different from the study of the special-purpose program approach from the standpoint of planning methodology. We must emphasize that management by means of the special-purpose program in the present context is something new. As a consequence there are a great number of different approaches which are more or less effective under a variety of conditions.

Peculiarities of Comprehensive Special-Purpose Programs as Entities To Be Managed

In the broad sense what we mean by a special-purpose program is a set of interrelated types of activity which are unified by the ultimate goal (or group of related goals) and by the technological-organizational unity of the process of attaining that goal regardless of the sectoral and departmental subordination of those performing the measures involved. As a rule the special-purpose program includes the following: a specific date for achievement of the final results; a hierarchical structure of the actions to be performed, which are subdivided into main programs, subprograms and program measures, into basic subprograms (embodying goals) and support (resource) subprograms, and so on; multivariant utilization of resources; and a varying

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makeup of participants in the program from stage to stage of its performance.

Special-purpose programs are shaped at various levels of management. The subject of our consideration are national economic programs aimed at solving major problems and at achieving results important to the country as a whole and requiring participation of many ministries and departments in their performance. At the same time there is a considerable interest in programs which have a functional or sectoral orientation (for example, overall research and development programs, programs for construction of major enterprises of sectorwide or industrywide significance, and so on) and in systems for horizontal management of projects within associations and enterprises or in matrix structures of organizational management. At these levels specific approaches are needed to planning and organizing programs, though the initial principles of the special-purpose program approach do have a certain universality.

The special-purpose program unifies in the structure of a single program the actions, forms and methods involved in the program planned to achieve a particular goal, it constitutes a special procedure for distribution of resources and economic incentives for performance of projects, and it constitutes a special system of followup and information support and also a separate entity to be managed. The problems in shaping and performing special-purpose programs require that requisite attention be paid equally to all aspects. But the most complex problems are obviously the organizational ones, since the intersectoral and interfunctional nature of the activities covered by the program makes it inevitable that the participants belong to different departments oriented toward attainment of final goals that often do not coincide with the tasks of each of the participating organizations taken separately.

In a sense the structural principles of organizational systems for management of programs will differ from those applied in the formation of individual enterprises, associations and ministries. The following might be included among these specific principles:

- i. subordination of all the interrelated activity to the final results for the national economy, clear definition of responsibility not so much for the amount of work to be done as for its overall result in spheres consuming the results of the program;
- ii. organizational unification under a common management of those performing all stages of the program from its drafting to its execution;
- iii. maximum proximity of the level of management of the measures contained in the program to the agencies performing them by eliminating superfluous intermediate levels in the system of managing the program;

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- iv. combination of one-man management and group responsibility in management, with particular attention paid to coordination of the measures contained in the program both up and down the management hierarchy and also among interacting agencies at a particular level;
- v. the most effective utilization of the capabilities of existing agencies by devising systems for management of programs without enlarging the management apparatus.

Under present conditions it is not possible to have uniform and unambiguous solutions for organizing the management of any of the special-purpose programs. Their organizational forms depend on the goals and the scale of activity, on the character of relations between them, on those sectors and industries which are dominant in execution of the program, on the influence of regional factors, and on the level of management where the most important decisions in the program might be taken.

Organization is an instrument for implementing economic policy, and therefore one needs to define the type of national economic program which is to be managed. In this connection it is advisable in our opinion to distinguish the following types of programs:

1. Nationwide programs aimed at accomplishing major socioeconomic goals of national economic importance, which simultaneously embrace various sectors of the production and nonproductive spheres, various domains of public life and of the natural and ecological system, and which cover international problems, etc. (programs for ocean resource development, environmental protection, improvement of the system of economic management, and for convergence of the socioeconomic conditions of urban and rural life can serve as examples).
2. Functional (multisector) national economic programs oriented toward solving major problems in developing of a group of sectors or toward performance of a comprehensive national economic task through the concerted efforts of a number of sectors and industries. Examples of such programs might be development of the country's fuel and power base; creation of a unified state network of computer centers; chemicalization of agriculture; development of a comprehensive system of transport services; mechanization and automation of auxiliary and service processes in industry so as to make manpower available, and so on.
3. Large-scale regional programs whose goal is to transform a particular region by virtue of development and comprehensive utilization of its natural resources, accelerated development of the leading sectors of the economy in the region, and development of a region by building an especially large project (complex). We might include here programs for development of the West Siberian petroleum and gas deposits, development of the agriculture of the Nonchernozem Zone of RSFSR, and economic development of the BAM [Baykal-Amur Trunk Rail Line] zone. In spite of the regional character of such

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programs, they have national economic significance, and their performance requires interdepartmental and intersectoral measures on the scale of the entire national economy.

4. Programs for special-purpose development (intersector or interregional) aimed at solving a key problem of one of the sectors, and eliminating disproportions or bottlenecks, at speeding up scientific-technical or social-and-cultural progress in a particular sphere, and so on. These might be, for example, the creation of a fundamentally new product or process and the organization of its production (a computer system, a synthetic material, a technology based on development of a scientific discovery, and so on); development of a particular type of services on a new organizational and technological basis (intersector enterprises for repair and tool service, networks for tourism and recreation, and so on); a rational change of proportions in location of the productive forces, and so on.

Along with a certain similarity of the final goals of these programs, they are characterized by the complex and multifarious interaction of sectors, regions and spheres of activity.

5. Programs for the organization of construction, whose goal is construction of major new projects of national economic importance or performance of major measures on the basis of a regrouping of existing projects (these would include creation of associations of the KamAZ [Kama Motor Vehicle Plant] type, regional industrial complexes and new cities).

In many cases the wrong level in the system of management of the national economy is chosen for concentrating the principal authorities in management of the program. This applies first of all to nationwide and functional programs. Attempts to use organizational systems headed by one of the sector-wide or industrywide ministries for management of such programs do not make it possible to ensure effective coordination of the measures in the programs because of the lack of sufficiently strong levers for exerting pressure on participants belonging to other sectors and industries.

Experience in drafting the program for natural conservation and optimum use of natural resources in Latvian SSR showed that overall management of natural conservation measures cannot be made the sole responsibility of the natural conservation division of the republic's gosplan, as had originally been envisaged. This kind of system will be effective only when a number of additional measures are being taken, especially with regard to all-union agencies which have enterprises within the republic (for example, the joint approval of schedules for natural conservation measures at these enterprises, appointment of responsible participants in central agencies).

In the performance of 200 comprehensive scientific-technical programs, a sizable portion of which pertained to functional programs or programs aimed at special-purpose development, it has become clear that the organization of their management is in need of improvement. The present system of management,

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which is based on head ministries, functions effectively only in those cases when the conditions for fulfillment of the programs are stable and no unforeseen circumstances and departures occur which have a substantial impact on fulfillment of commitments by coparticipants.

Not uncommonly ministries and departments do not allocate the financial, labor and material resources necessary to performance of the specific program. In these cases neither the head ministry nor the State Committee for Science and Technology of the USSR Council of Ministers has sufficient means of exerting pressure and resources for timely correction of the situation. The result is that the 1977 state plan for these scientific-technical programs was not altogether fulfilled: 94.7 percent in terms of the number of assignments, 96 percent in terms of the extent of application, and 97 percent in terms of the solution of scientific-technical problems.

Comprehensive regional programs are a most complicated entity to manage, since on the one hand regional agencies (republic or oblast agencies or agencies set up in the system of all-union ministries) have the decisive role in managing them, while on the other the programs are manifestly intersector and interdepartmental in nature, which necessitates that managerial pressures be exerted at the level of the entire national economy. Here it is especially important to achieve optimum combination of centralization and decentralization in the system of program management. Meanwhile in regional development programs involving the construction of major projects, the greatest success has been in solving the problems of organizing that portion of the programs specifically related to construction (through the facilities of such organizations as Bratskgesstroy [Organization for Construction of the Bratskaya GES], Glavbamstroy [Main Administration for Construction of the BAM], and so on). Moreover, the national economic plan is an important instrument for the fulfillment of programs. But this kind of system remains incomplete from the standpoint of the entire system of measures directed toward achievement of the program's final goals. To be specific, it does not directly embrace the "consuming" subprograms, including the development of capacities, the building of settlements and infrastructure by the date when the principal fuel and power, transportation and other facilities go into operation.

The problem of the organizational tieup of the scientific projection of future utilization of the region's resources with the specific measures contained in medium-term and long-range plans for the development of the production and nonproductive spheres is especially urgent. It can be solved by organizing operational interaction of subdivisions drafting and carrying out the relevant measures both in regional terms and also in sectoral terms. This kind of interaction can be set up either by creating a group system for consideration and adoption of planning decisions or by subordinating all participants to a specialized management organ responsible for drafting the program and coordinating its execution.

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Finally, programs for special-purpose development and programs oriented toward specific projects are the simplest to fit into the existing regional-sectoral system of management, since for them it is easy enough to distinguish the authoritative level of management of the entire program in a union (republic) ministry, department or in the republic council of ministers. In this case the administrative-organizational relations in the line-functional system of management remain in effect to a considerable degree. But even in this case there is a need for intersector and interdepartmental coordination.

The success of programs for special-purpose development depends in large part on staff services that are working well in gathering and processing all information on the program and which make it possible for management personnel to take timely steps to correct deviations that are noted. There is also a need to regulate and monitor the work of those actually performing measures under the program and which have dual subordination--to the managers of the program and to the chief of their own department in line management.

The objective character of the organizational-and-technological relations among the measures contained in the program, the degree of their complexity and their orientation have a decisive impact on selection of the management mechanism. The simplest type of communications is when achievement of the final goal of the program is stated as the sum total of more or less autonomous efforts of different departments which receive resources from a common fund of the program. The following are examples of such programs: regional environmental protection; development of one or several sectors or industries on an interregional basis; application of technical innovations (a new process or material) in different spheres of production.

In this case it is important to devise a unified policy under the program, to establish priorities governing resource allocation, to assess the economic efficiency of the measures contained in the program, and to plan the end results and resources to be allocated in a rational way. As a rule no serious problems arise in operational coordination of the activities involved in execution in this case. Such programs can be called "discrete comprehensive programs."

In the second class we put programs whose final goal is achieved by the successive use of intermediate results (cooperation), but it differs qualitatively from them. Such programs might be called "interrelated comprehensive programs." The important thing here is the character of the relations. If they are mainly sequential (that is, the program contains more or less standardized stages which can be adequately evaluated as to the amount of work to be done, the date of completion, the resources required, and so on), then the decisive role in their management is played by subdivisions capable of drafting clear and detailed plans and work schedules and of providing the operational regulation of their fulfillment. This is especially typical of construction programs.

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In certain situations (for example, in the scientific development and experimental creation of sophisticated technical systems and when they are put into production) the technical-and-organizational relations are multifarious in nature, the detailed descriptions of stages and jobs are defined only with a certain degree of approximation, and during fulfillment of the program new tasks may be assigned and substantial adjustments made in the original project plan. In these cases coordination through the plan alone is inadequate.

Organizational Forms of Management of National Economic Programs and the Conditions for Their Application

Centralized program control is the simplest from the organizational standpoint. It is based on creation of a specialized management agency, at the top level of the national economic hierarchy as a rule, which is allotted the resources under the program and bears full responsibility for its accomplishment. This may be an agency of the same class as a sectorwide or industrywide ministry or a functional department characterized by its own line-functional structure. This form is most effective for management of nationwide and functional multisector programs.

In all these cases we are talking about managing large-scale programs (nationwide, functional, and sometimes comprehensive regional programs), in which there is a need to make decisions concerning the national economic plan as a whole, for constant coordination of the activity of several major sectors or industries, for allocation and redistribution of large amounts of capital investments and material and technical resources, which as a rule can be done only at the top level of management of the national economy with the active participation of USSR Gosplan.

The first type of centralized system--direct subordination of all participants in the program to a commission or other government agency--is best set up in the case when the character of the program requires not only that a general policy and strategy be devised for its implementation, but also a large amount of ongoing coordinating work among major sectors and industries. For instance, the commission for fuel and power problems or food problems may be the authoritative management agency for joint decisionmaking in which the heads of departments and ministries may make important decisions concerning interrelated fulfillment of the program. Thus supradepartmental management of a specific program can be provided for, and at the same time overloading of top-level management agencies with a large number of specialized matters is avoided. An important role here is played by expert evaluation on interdepartmental matters related to shaping and fulfilling the programs. One might take as a basis the present system of expert evaluation in USSR Gosplan, which could be the basis for setting up ad hoc or standing special-purpose councils of experts.

The second type of centralized management of a program is the formation of a new ministry (state committee). Examples of arrangements of this type might

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be the creation of committees for atomic energy and manpower resources, republic committees for natural conservation, and a number of machinebuilding ministries. As a rule it is advisable to set up this type of new agency when a long-term concentration of resources is involved. They are directly allocated either to the new agency, which is developing the production facility, or they are extended under the control of that agency within the limits of the unified technical and economic policy it has worked out. The main problem associated with this approach is organizing management of the program on a departmental basis.

The third type of centralized management obtains its structure from functional subordination of the participants in the program to the coordinating division of one of the government departments (USSR Gosplan, the State Committee for Science and Technology, and so on). It is preferable for large-scale programs in which the decisive role is played by scientific methods work and the planning of the measures to be carried out in the program and by periodic followup on their execution. These might be, for example, programs for interrelated creation of ASU, comprehensive mechanization and automation of production processes in the national economy. This kind of organizational arrangement is the simplest to fit into the present structure of management, but it is not universal. One of the principal places for its effective use is in "discrete comprehensive" programs which do not require any considerable amount of work in operational regulation.

But management programs based on setting up centralized systems for management and concentration of authorities at the top level of management of the national economy is neither objectively necessary nor effective for a majority of programs, even though they are intersectoral and interdepartmental in nature. There are so many national economic programs that there are limited opportunities for setting up new centralized agencies. The optimum forms of organization for management of programs, then, might be structures that provide for a certain decentralization and extensive use of horizontal interactions in the process of planning, coordinating and executing the measures contained in the program.

The form that is most widespread at the present time is program management on the basis of a head organization, which with certain improvements might be effective for comprehensive regional programs, for a number of programs aimed at special-purpose development and particularly for programs covering the organization of construction. The standard approach is for the head organization (for example, Glavbamtroy, Glavsevmorput' [Main Administration of the Northern Sea Route], and Glavnechernozemvodstroy [Main Administration for Hydraulic Engineering Construction in the Nonchernozem Zone]) is designated as a rule in the ministry performing the major part of the work and bearing responsibility for achievement of the final result of the program. The principal problem in using this scheme is to guarantee effective coordination and effective influence on participants in the program belonging to other ministries and departments. An analysis of experience in management of special-interest programs shows that the principal requirement is to set

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up relevant planning and coordinating subdivisions within the head department which work out plans for the program as a whole and which also provide ongoing coordination of the activity of all coparticipants in the elements of the program (in the case of "interrelated comprehensive" programs).

At the same time, the head department must obtain additional authority to distribute resources, to evaluate work done by the participants, and to regulate their use of incentive funds, to verify progress, and so on. This will afford the possibility of exerting effective pressure on the participants in the program at the middle level of management (in the horizontal direction). Thus this form contains certain features of the "matrix structure" of management. In this form it is indispensable to create an interdepartmental coordinating council for the program. It may be set up in the head ministry, in USSR Gosplan, or in the State Committee for Science and Technology depending on the scale, complexity and importance of the program.

Attention should also be paid to use of a variant of the coordinating form of management which consists of creating an intersector regional production-economic organization (of which Bratskgesstroy is a model), to which enterprises of other sectors in the production and nonproductive spheres are made temporarily subordinate. As the program is completed, the association can be dissolved, enterprises are returned to their departmental subordination, or status and functions are considerably altered as a function of the tasks in current management of the complex that has been built.

The matrix structure of management of the special-purpose program is a new form of organization based on maximum use of the agencies that exist in the management system and on organizing their combined interaction: vertical interaction in accordance with the relations of management and subordination that exist; horizontal interaction on the basis of a considerable redistribution of authority so as to enhance the role of the middle tier of management. It is now being checked out on an experimental basis in management of the program for natural conservation and optimum use of natural resources in Latvian SSR and management of certain other special-purpose programs. Here management of the program is provided at the top level of the national economic system, but the principal work of managing the program is transferred to the middle level of management.

Interaction of the newly created special-purpose program structure and the existing line-function structure is achieved through combination of the functions of the top and lower levels of management in both systems (see the diagram). The flexibility of the special-purpose structures, which are oriented toward the final result, and the stability of the existing departmental line-function structure results from a partial redistribution of authorities and functions of the different levels with respect to the resources and results of the program. The nucleus of the matrix structure is the specialized unit for management of the program, which operates on the basis of authority granted it by the higher-level governmental agency. In principle this unit may be designated either in one of the ministries or departments or newly created as an independent agency of the government apparatus.

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An important role is played by the council for coordinating the program, which is expected to solve the most important problems of the authoritative managers at the highest level. The program director is like the executive director of that agency. Under him is the coordinating-staff subdivision, whose task it is to prepare decisions in the stage of the program's formation and planning and to organize its execution and general followup on progress. Subprogram coordinators are also designated in the case of especially complicated and large programs. Their task, like that of the program manager, is to see, along with the coordinating-staff agency, that all the measures in the program are oriented toward the final goals of the program, which frequently differ from the current goals and interests of the participating departments.

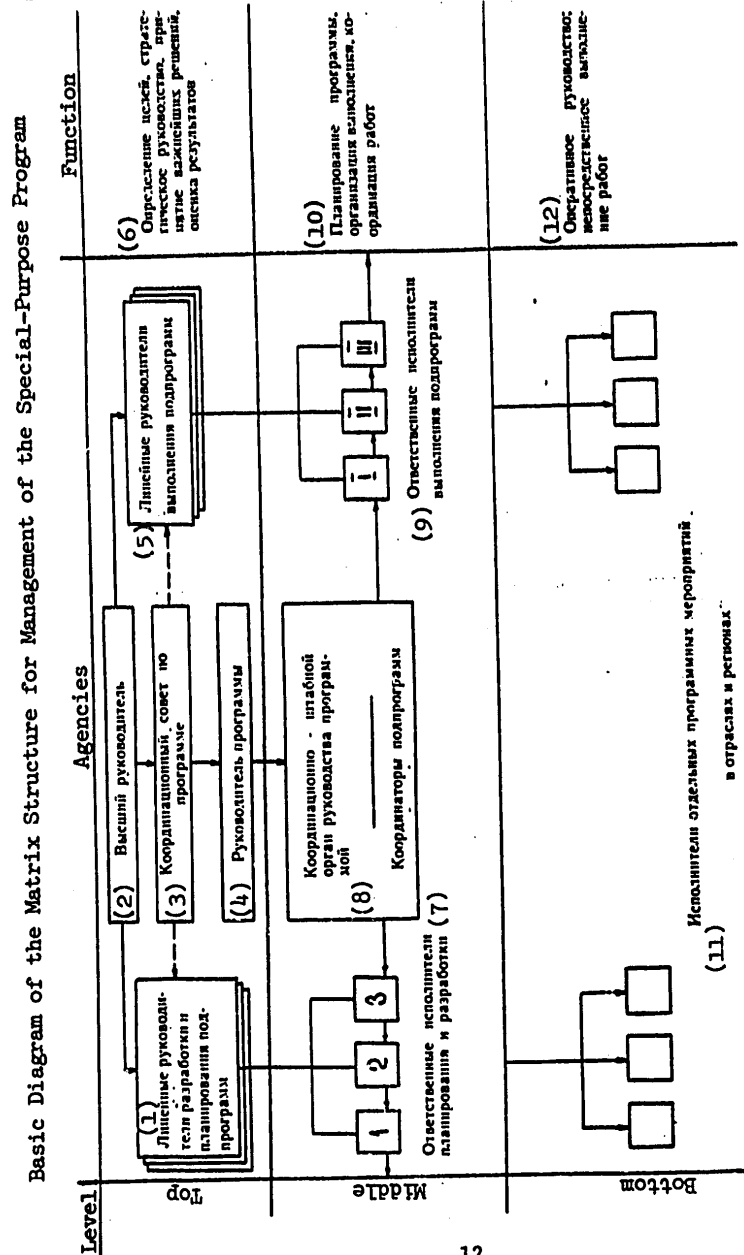
As a rule the program is carried out by subdivisions which have line-function systems. Within ministries and departments responsibility for performance of all the measures contained in the program must be specifically assigned to those responsible, which have dual subordination: administrative (vertical) to the manager of their department (on general matters of technical policy, on expenditure of resources and funds for the measures contained in the program, for organization of work at participating enterprises), and functional (horizontal) to the the program manager (on matters of deadlines for achievement of results, technical and other specifications, and quality and efficiency of performance).

The matrix structure of management is a principle for structuring an organizational mechanism which can take the most varied form in practice as a function of the location of the unit designated for management of the program and the kind of authority vested in its manager. For instance, in the present system of management of the program for environmental protection of Latvian SSR the following subsystems have been introduced: general management of the program (the manager of the comprehensive program, a commission of the Latvian Council of Ministers, and the collegium of the republic gosplan); the drafting and planning of the program (the problems council for the program, the natural conservation division of Latvian Gosplan, the divisions for specific sectors and industries, and scientific and project planning and design organizations); execution of the program (chief coordinators of subprograms in the head ministries and departments, responsible officials in organizations carrying out the measures contained in subprograms); and information support of management of the program (subdivisions of Latvian Central Statistical Administration).

In another design of the matrix structure for management of programs for development of the industry of Moscow an interdepartmental committee for drafting programs for development of Moscow's industry and for following up on execution has been proposed as a collegial management agency; the agency for elaborating the plan would be the subdivision for industrial development programs of the summary division of Mosgorplan; and the agency for operational management would be the comprehensive program manager in Mosgorispolkom, who is responsible to the union agencies for performance of the entire

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program and the staff division for management of Moscow's industrial development programs, which is subordinate to him.



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Key to diagram:

1. Line managers for drafting and planning subprograms
2. Top manager
3. Coordinating council for the program
4. Program manager
5. Line managers for fulfillment of subprograms
6. Definition of goals, strategic management, adoption of the most important decisions, and assessment of performance
7. Participants responsible for planning and development
8. Coordinating-staff agency for management of the program; subprogram coordinators
9. Participants responsible for performance of subprograms
10. Planning the program, organization of execution and coordination of projects involved
11. Participants performing the individual measures contained in the programs in particular sectors and industries and in particular regions
12. Operational management; actual performance of jobs

It is important to emphasize that even though the matrix structures do ensure the greatest flexibility in management of the program at minimum cost (by contrast with the creation of new agencies for centralized management of programs), they also raise the most complex problems for the organization of management. This has to do with the difficulties of organizing dual subordination, the need for balanced horizontal distribution of authority and responsibility, strict regulation of organizational relations on the one hand, while on the other all participants in the program are given subjective opportunities and possess the capabilities for solving most of the problems that arise in interaction without appealing to higher-level agencies.

So as to achieve combination of the program-by-program, sector-by-sector and region-by-region cross sections of national economic planning when matrix structures of managing comprehensive national economic programs are used, it is above all necessary to enhance the role of USSR Gosplan and the USSR State Committee for Science and Technology, to give them responsibilities for the functions of balancing the relevant programs and linking them to the plans of sectors and industries. Since the number of comprehensive national economic programs may be rather large, it is advisable to take up the question of creating a summary division (subdivision) in USSR Gosplan for planning special-purpose programs. This does not mean that such agencies should replace or duplicate the functions of program managers nor those of departments or ministries. Their principal task would be to act as the connecting link between the top level of economic management and the systems for special-purpose management of major national economic programs at the lower level, taking as their points of departure the interests of the entire national economy and achievement of sound preparation and adoption of the most important decisions.

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Since the nationwide system for management of special-purpose programs is to be set up for the first time, the legal bases have to be worked out for its functioning as well as normative and methods guidelines governing interaction of sectoral and regional agencies and agencies specific to management of the special-purpose programs. The time has also come to draft the "Regulation on Planning and Management of Comprehensive National Economic Programs." This document should regulate the new relations arising among economic agencies when systems for management of special-purpose programs are set up and should systematize the organizational and methods aspect of the management mechanism that is created. The development and introduction in the national economy of large-scale special-purpose programs as a new form of planning and management should moreover become itself an entity subject to the special-purpose program approach.

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EFFICIENCY, PRICE, OBSOLESCENCE OF EQUIPMENT

Moscow VOPROSY EKONOMIKI in Russian No 6, Jun 79 pp 22-32

[Article by L. Shevchenko, Kiev]

[Text] Among the economic levers for controlling scientific-technical progress, one that is of great importance is the wholesale price of the new technology. The ability of price to be a gauge of the socially necessary expenditures of labor provides the opportunity to use it to determine the economic effectiveness of the production and consumption of individual types of output. Thus it executes the function of a control on the level of effectiveness of the new output. In addition, the wholesale price should assure the economic self-interestedness of the enterprises in the production and application of new, highly effective articles and the reduction in that self-interestedness as the output becomes obsolete. The execution of the incentive-producing function is possible provided there is a substantiation of the level of the planned price of the new output and the regulating of that level in proportion to the assimilation of the production of the output and its obsolescence. Both functions of the wholesale price are interrelated¹.

Under present-day conditions, wholesale price not only reflects the developing level of expenditures for the production of output, but also acts simultaneously as an instrument for controlling the level of those expenditures. Naturally, the use of price as such an instrument presupposes the creation of the appropriate economic conditions for the implementation of the functions embodied in the price. The currently effective Methodology for Determining the Wholesale Prices of New Output Destined for Technical and Production Use did not resolve, in our opinion, to a sufficiently complete extent such an important question in the area of planned price determination as the reflection of the influence exerted by the levels of effectiveness of the new technology (their dynamics in proportion to the obsolescence of the technology) upon the extent of the wholesale prices. Hence no provision is made for a control on the growth of the economic effectiveness of the types of technology which are being created, for the preventing of the unsubstantiated increase in wholesale prices, or the reduction of those prices under the influence of obsolescence.

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This task can be resolved, in our opinion, on the basis of a study of the interdependence between the indicator of the effectiveness of the new technology in production (and application) and the extent of the planned price. By making use of the interdependence between these two values it is possible, first of all, by knowing the price (or forecasting its level), to compute the indicator of effectiveness of the replacing types of technology; secondly, by planning the growth of the indicator of effectiveness, to determine the maximum level of the price of the new technology, which increase assures the attainment of that growth.

The upper limit of the price ($T_{s_{vp}}$) is generally considered to be that level which creates for the consumer an equal advantageousness in the application of the new and the base technology. However, in actuality, what is assured is not equal advantageousness, but the equality of the reduced expenditures of the types of technology which are being compared, and these are not the same thing. The equal advantageous of the application of the new and the base technology, with a new-technology price level that is equal to the upper limit will occur only in the event that the indicator of effectiveness in the consumption sphere corresponds to the normative coefficient of effectiveness (Y_{e_n}), which is a specific instance.

The normative coefficient of effectiveness of capital investments indicates the lower limit of effectiveness, the boundary of the economic desirability of the production and application of the new technology from the positions of the national economy as a whole and serves as the basis for the selection of the new types of technology. As a result of this selection, the types of technology which are deemed to be economically desirable for assimilation will be those whose coefficient of effectiveness will be greater than the normative one.

However, in order to evaluate the economic desirability of creating and introducing new technology, it is necessary to know the extent to which the coefficient of effectiveness of the new technology should be greater than the normative one. The solution of this task should be approached from the position of the interrelationship between the national-economic effectiveness and the cost-accountability effectiveness of the new technology. The cost-accountability incentives for the production and application of new technology are not assured automatically. The national-economic benefit is realized through the cost-accounting benefit, which finds reflection in the change of the indicators of the economic-production activity of the individual enterprises. In order to make the transition from the normative coefficient of effectiveness (as the initial one in the selection of the new types of technology) to the evaluation of the increase in the cost-accountability effectiveness of the new technology in the sphere of its consumption, it is necessary to select that indicator whose level could be compared with the coefficient of effectiveness of capital investments, and, on the basis of that result, judge the execution of the condition of the increase in the effectiveness of the new technology as compared with the technology that is to be replaced.

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As an indicator of the effectiveness in the sphere of consumption of the new technology, for making a comparison with the coefficient of effectiveness of capital investments, one can use the indicator of profitability (R). These two indicators (coefficient of effectiveness and indicator of profitability) differ in their content and in their quantitative significance, but their levels are interrelated in such a way that the profitability of production (in the sphere of application) can rise only with the proviso that the coefficient of effectiveness of capital investments is higher than the indicator of profitability. This dependence between the levels of these indicators makes it completely admissible to compare them. In the instance when the indicator of profitability (R) is greater than the normative coefficient (Y_{e_n}), the use of the technology with a wholesale-price level that is equal to the upper limit would cause for the consumer a reduction in the overall profitability of its production, and that would mean the violation of the condition specifying the increase in the effectiveness of the new technology as compared with the base technology.

It is important to examine how the requirement of the increase in the economic effectiveness of the new technology influences the level of the wholesale price when there the consumer has different levels of effectiveness of production (profitability), which will make it possible beforehand to determine the wholesale price that corresponds to the planned level of profitability. For this purpose it is necessary to study first of all the interdependence between the levels of the indicator of the effectiveness of production in the sphere of application of the new technology and its wholesale price.

In economic literature the opinion is expressed that the economic benefit derived from the use of new technology (the indicator of effectiveness) does not depend upon the price level, inasmuch as the benefit is redistributed through it between the producer and the consumer². In our opinion, there is some imprecision here. The economic benefit does not depend only upon that part of the difference between the upper and the lower limits of the price, which part is included in the planned price. Therefore, when considering wholesale price as an instrument for the economic encouragement of the creation and introduction of new technology, as a means of taking into consideration the cost-accounting interests of its producers and consumers, it is completely justified, when computing the increase in the effectiveness of the new technology as compared with the technology which is to be replaced, to take into consideration the role of the wholesale price as an incentive.

When determining the encouraging role of price in the application of new technology as a means of assuring the increase in effectiveness in the sphere of its consumption, one can compute the price level that corresponds to that condition. It must created in the sphere of application a kind of "profitability reserve" that assures both the planned rates of increase in the labor productivity and the reduction of the production costs, and the compensation of the losses linked with the process of assimilating the new technology, and also the providing of material incentives for its rapid and effective

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assimilation. Corresponding to this requirement is the incentive level of profitability (R_g), which must be higher than the normative coefficient of effectiveness and the branch normative of profitability ($R_g > R > Y_{e_n}$).

The extent of the incentive level of profitability can be computed either on the basis of the planned or actual data pertaining to an analogous type of output, or on the basis of a kind of norm depending upon the extent of the introduction of the new technology. In our opinion, this norm should be determined with a consideration of such initial values (requirements) as: a) the planned rates for the annual reduction in the production costs of output as a result of the scientific-technical progress in the branch; b) the losses in profit as a result of the increase in production costs and the reduction in the volume of production, which are caused by the assimilation of the new output in production, as well as the needs for the planned increase in the funds for material incentives; and c) the existing branch norm for profitability.

The studies carried out by us in a number of branches with a consideration of the rates of reduction of the production costs, the losses borne by the consumer of the new technology, and the necessity of providing him with material incentives have indicated that the increase in the effectiveness (the "profitability reserve") in such branches of application of new technology as machine-tool construction and metal-working should constitute 0.08-0.12, and the value of the incentive level of profitability, for example, when $R = Y_{e_n} = 0.15$, will constitute respectively 0.23-0.27 (when $R > Y_{e_n}$, it will be greater).

Proceeding from the fact that the incentive level of the indicator of the effectiveness of new technology in the sphere of application (R_g) is known, one can compute the maximum figure for the price which guarantees that level. The formula for computing the maximum price value that assures the effectiveness of the use of the new type of technology at the R_g (Ts_2) level is derived analogously to the formula for the upper limit of the price, except that, instead of the normative coefficient of effectiveness (Y_{e_n}), one substitutes the indicator for the incentive level of profitability (R_g):

$$U_2 = U_1 \cdot a_{np} \cdot \frac{\frac{1}{T_1} + R_c}{\frac{1}{T_2} + R_c} + \frac{H_1 - H_2 \pm K_a \left(\frac{1}{T_2} + R_c \right)}{\frac{1}{T_1} + R_c} \quad (1)$$

where I_1, I_2 are the annual current costs of the consumer when using the base and the new types of technology, in terms of the volume of output to be produced with the aid of the new technology; T_1 and T_2 are the life of the base and the new technology; Ts_1 is the price of the unit of the base type of technology; a_{pr} is the coefficient of change in the annual volume of output (productivity) to be produced with the use of the new technology, as compared

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with the base technology; and K_d is the additional capital investments of the consumer of the new technology (excluding the value of the types of technology which are being considered),

The level of the price which has been computed according to formula (1) will be below the upper price limit and can assure the economic self-interestedness of the consumer in the use of the new technology. This content of the wholesale price corresponds to the definition of the limit price ($Ts_2 = Ts_l$)*. The limit price, in addition to the fact that it indicates the limit of the increase in the price of the new technology from the point of view of the cost-accounting interests of its consumer, executes the role of a kind of distributor of the economic benefit from the application of the new type of technology. The share of the economic benefit which is directed to the consumer of the new technology throughout its lifetime will be equal to the difference between the upper price limit and the limit price ($Ts_{vp} - Ts_l$).

Assuring a control over the level of effectiveness of the new technology with the aid of price requires a kind of "measurement tool" -- a list of the indicators which make it possible to determine the economically substantiated increase in the price of the new technology as compared with the price of the base technology, as well as the necessary degree of reduction both of the upper price limit and the wholesale price (under the influence of the obsolescence of the technology) in order to increase the effectiveness of the application of the technology.

In order to determine these indicators, let us use the two new-technology price levels that are similar in form of notation and structure: Ts_{vp} and Ts_l (1), which are distinguished by the value of the assured coefficient of effectiveness of application of that technology (Ye_n and R_s). From the correlation of those values (Ts_{vp} and Ts_l) and the price (Ts_1) of the old (base)

we obtain the coefficients $\frac{T_{s_{vp}}}{T_{s_1}}$ and $\frac{T_{s_l}}{T_{s_1}}$, which make it possible to

determine the admissible increase in the price of the new technology as compared with the base technology: in the first instance, with effectiveness of its application at the level of the normative coefficient of effectiveness (Ye_n), and in the second instance, on the level of coefficient of effectiveness that provides an incentive for the consumer to use the new technology (R_s). In

general form, the indicators of the price correlation $\frac{T_{s_{vp}}}{T_{s_1}}$ and $\frac{T_{s_l}}{T_{s_1}}$ can be

* [Tr. note: Italic is used to distinguish letter "l" as transliteration of Russian letter from numeral "1."]

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written as follows:

$$\alpha_{np} \cdot \frac{\left(\frac{1}{T_1} + E\right)}{\left(\frac{1}{T_2} + E\right)} \left[1 + \frac{H_1 - H_2 \pm K_n \left(\frac{1}{T_2} + E\right)}{U_1 \cdot \alpha_{np} \left(\frac{1}{T_1} + E\right)} \right], \quad (2)$$

where Y_e is the coefficient of effectiveness of the new technology for the consumer (Y_e , R , R_g).

What is the content of the indicator derived by us? If one proceeds from the fact that it was obtained as a result of the comparison of prices of new and old technology, then, obviously, it indicates the change in the price of the new technology as compared with the base technology, depending upon the change in the level of its consumer properties. With regard to structure, this indicator represents the product of three values: the coefficient of the change in the annual production of output -- α_{pr} , the longevity coefficient

-- $u_i \left(\frac{\frac{1}{T_1} + E}{\frac{1}{T_2} + E} \right)$ and a third cofactor, which indicates the influence that the

replacement of the old technology by the new technology has upon the effectiveness of production for the consumer (it exceeds unity by the value of the correlation of the conditional annual economy and the total sum, reduced to the year, of the expenditures for the reproduction of the old technology, but in a volume equivalent to the productivity of the new technology. This makes it possible to call the third cofactor the coefficient of economic advantage -- α_e . With this approach to the determination of the content

of the obtained indicator (2), we see that it reflects the complete change in the consumer properties of the new technology as compared with the base technology. It can be called the integral coefficient of replaceability of the old technology by the new (according to the level of the consumer properties and the expenditures corresponding to them) -- α_1 .

The economic sense of the integral coefficient of replaceability (2) lies in the fact that with its help the expenditures for the type of technology that is to be replaced can be reduced to a comparable level of consumer properties of the new technology. It can be used to evaluate the acceptability of the level of the price of the new type of output from the point of view of the fulfillment of the condition stipulating the increase in its effectiveness as compared with the base technology.

The condition of acceptability of the price (and, consequently, the condition of the increase in the effectiveness of the new types of technology as compared with those that are to be replaced) can be written as follows:

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$$U_2 < U_1 \cdot \alpha_H \quad (3)$$

That means that the expenditures incurred per unit of increase in the consumer properties of the new technology must be below the expenditures to assure the level of consumer properties of the technology to be replaced, and this will be the guarantee of the increase in the effectiveness of the new technology as compared with the base technology and the guarantee of preventing an economically unsubstantiated increase in the prices of new types of it.

Depending upon the value of Y_e which is used in formula (2), the level of the integral coefficient of replaceability can vary from α_{is} -- incentive level (with $Y_e = R_s$) to α_i makes -- the maximum (with $Y_e = Y_{e_n}$). Substituting in formula (3) the various values of the integral coefficient of replaceability, the condition of the acceptability of the price of the new technology in each instance can be rendered concrete by the regulated level of the indicator of the effectiveness of its application.

Thus, with the aid of the integral coefficient of replaceability (α_i) it is possible to resolve one of the posed tasks -- to determine the limit of the increase in the price of new output as compared with the base output, with the guarantee of the regulated level of effectiveness of its application. The ratio of the incentive level of the integral coefficient of replaceability to the maximum one makes it possible to determine the required degree of reduction of the maximum value of the price (upper limit) for achieving an increase in effectiveness of application of the technology from Y_{e_n} to R_s :

$$\frac{\alpha_{is}}{\alpha_{i \text{ макс}}} = B'. \quad (4)$$

Using coefficient V' , one can determine the limit price: $Ts_L = Ts_{vp} \cdot V'$.

It should be noted that a condition for the correct determination of the limit price as the maximally admissible figure for the price that creates economic self-interestedness in the consumption of the new technology is the assurance of the reliability and substantiation of all the initial data (the task analogous to the one that is resolved when establishing the upper price limit).

The computations that we made for coefficient V' for the group of new types of output in machine-building output indicated that its value is within the confines of a rather broad interval -- from 0.95 to 0.6. Therefore, in practical computations one should not employ its average value; instead, it is necessary to make computations for individual groups that are close to the level of effectiveness in the sphere of application (or in each specific instance).

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In certain instances (when $V' > 0.8$), the levels of the limit prices that have been computed in conformity with the proposed method can prove to be above the levels of the limit prices computed on the basis of the existing Methodology for Determining Wholesale Prices³. However, this is not equivalent to the recommendation concerning the increasing of the existing wholesale prices of new types of technology, because, first, what we are dealing with is limit prices (rather than prices according to which the new output is sold to the consumer); secondly, in other instances (when $V' < 0.8$), the levels of the limit prices will prove to be below the levels computed in conformity with the existing Methodology. In addition, it is necessary to re-emphasize that, regardless of whether the limit price is higher than or lower than that which is computed in conformity with the Methodology, the application of the new technology with a price level no higher than the limit level will provide the consumer with an incentive level of profitability (R_g), whereas, if the existing computation method is used, this is not always achieved.

The use of the indicator (V') derived by us will guarantee the incentive role of wholesale price in the sphere of application of new technology. However, this role of it must manifest itself both in the consumption sphere and in the sphere of production of the new technology. Therefore the next stage in research should be the analysis of the influence exerted by the limit price level (1) upon the effectiveness of the production of the new technology. At this stage it is necessary to determine the limit of the increase in the current expenditures for the production of the new output and the coefficient of the possible reduction of those expenditures to assure the increase in the profitability of production (and, consequently, the possibility of the providing of an economic incentive for the producer).

The providing of an incentive for the producer of new technology with the aid of price means, first of all, that the price of the new output must include an increased level of profitability (R_2) as compared with the existing branch norm for the profitability of output (R_n). Excess (R_2 exceeding R_n) that makes it possible to form an incentive price mark-up, which is part of the economic benefit to be obtained in the sphere of application of the new technology, must be sufficient, in our opinion, to compensate the expenditures for the assimilation of the new output, and the losses in profit, and for the increase in the material-incentive funds to encourage the participants to create and introduce the new technology. The ratio $\frac{R_2}{R_n}$, as has been shown by computations, constitutes approximately 1.55-1.58. The overall price level should not exceed that level which is acceptable for the consumer and which guarantees an increase in the effectiveness in the sphere of application (1).

That means that the guaranteeing of an increased level of profitability in the production of the new technology, with the guarantee of an increase in the effectiveness of its application, which is expressed by the price level

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assigned for the producer ($Ts_2 = Ts_1$), can be achieved by retaining (not exceeding) the definite level of expenditures (production costs) for its production. This level of production costs (S_2) can be written as follows:

$$C_2 = \frac{U_n}{1 + P_2} \quad (5)$$

The level of production costs in formula (5) is called the maximum or limit level ($S_2 = S'_2$), since it indicates the limit of the growth of the current expenditures that make it possible to assure the economic self-interestedness of the producer and the consumer in the new technology. One can also define the necessary degree of reduction of the production costs of the new output for the purpose of assuring an increase in the profitability of its production as compared, for example, with the branch norm (R_n):

$$\frac{C_2}{C'_2} = \frac{1 + P_n}{1 + P_2} = B'' \quad (6)$$

where S_2 and S'_2 are the production costs of the new output which correspond to the levels of profitability R_n and R_2 .

Coefficient V'' indicates the extent to which the production costs of the new output must drop in order for its profitability of production to increase (with the price level remaining constant) from the normative level to the level that encourages the producer (R_2). Coefficient V'' can be applied not only to the amount of the production costs, but also to the price as a whole, if its structure corresponds to: $Ts = S(1 + R_n)$.

Thus, proceeding from the assigned task, we have at our disposal two derived coefficient -- V' and V'' (formulae 4, 6). The former makes it possible to determine the price level for the new technology which guarantees the increase of the effectiveness in the sphere of its application; the latter, the level of expenditures for the new technology, the preservation of which level guarantees the increase in the profitability of its production. The use of the latter coefficient -- V'' -- continues the action of the former -- V' , inasmuch as the price level computed on the basis of the former coefficient is the initial value for determining the level of expenditures (that is, the use of the latter coefficient). This interrelationship between these coefficients makes them partial coefficients for reduction of expenditures and provides the possibility, on their basis, of deriving the overall coefficient for reduction of expenditures (V) for the new technology (as compared with the maximally permissible level of those expenditures)⁴. With the aid of the latter it is possible to establish the level of expenditures for the new technology, which level assures the increase in effectiveness (and, consequently, the economic self-interestedness) both in the sphere of application ($Ye_n \rightarrow R_s$) and in the sphere of production ($R_n \rightarrow R_2$).

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The overall coefficient for reduction of the expenditures (price) can be written as follows:

$$B = B' \cdot B'' = \frac{\alpha_{nn}}{\alpha_{n \text{ MARG}}} \cdot \frac{1 + P_n}{1 + P_2} \quad (7)$$

Thus, the indicators of the effectiveness of the new technology in the spheres of its production and application are dependent upon the level and structure of the wholesale price. The higher the indicator of effectiveness of the application of technology, the lower, relatively speaking, the price of that technology can be, and the assuring of the rise in the indicator of effectiveness of production of the technology will depend upon the limiting of the expenditures (production costs) for the new technology. This confirms the previously advanced thesis concerning the interrelationship between the incentive function of the wholesale price and the controlling function, the regulation of the level of effectiveness of the new technology.

The acceleration of the rates of scientific-technical progress is intensifying the degree of obsolescence of machinery and equipment. The reflection of the obsolescence of the technology in the price, while part of the overall problem of accounting for the obsolescence of the output, has certain peculiarities and requires the development of methodological principles dealing with the accounting of it. First of all, it is necessary to note the connection that the basic principles of price establishment for various types of interchangeable technology have with the accounting for the obsolescence in the price.

One of the basic principles for the construction of prices is bringing them close to the level of the socially necessary expenditures. The observance of this principle brings about the need for accounting, in the price, for the dynamics of the socially necessary expenditures and the influence exerted by the increase in the social productivity of labor, and this, in essence, is equivalent to accounting in the price for the obsolescence of the first type. A no less important principle for the construction of wholesale prices of products destined for technical and production use is the accounting in the price for the level of economic effectiveness of the output and the change in that level as the output becomes obsolete and new models appear, which is directly linked with the manifestation of the second type of obsolescence.

The actual level of the obsolescence of the technology can be judged only after the appearance in production and the application of the new type of technology. However, the influence that obsolescence exerts upon price should be forecast and regulated when constructing the dynamic planned price, taking into consideration its incentive function (that is, the interrelationship between the price level and the indicators of the enterprises' production activity). For this purpose one can make use of the underlying natural laws governing the dynamics of the indicators of the effectiveness of the technology being produced (used) and its new models.

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For accounting for the obsolescence of technology in wholesale prices there are a number of recommendations in the economic literature. It is proposed, in particular, when computing the upper level of the price, to replace the service lives with indicators of the renewability of the articles⁵. The economic benefit included in the formula for the upper limit will be reduced, since it is taken into consideration here not for the entire service life, but for the period up until the advent of the obsolescence. In addition, in order to account for the influence of the obsolescence, it is recommended that one adjust the price of the base article by a factor that takes into consideration the rates of reduction of the benefit and the socially necessary costs during the period from the issuance of the construction-planning assignment until the beginning of the series production. In order to reflect the obsolescence in graduated prices, it is recommended that one use a system of rebates⁶. The implementation of these recommendation makes it possible to a definite degree to reflect the factor of the obsolescence of various types of technology in the wholesale prices.

In order to compute the obsolescence of the first type, one usually uses the coefficient for price reduction:

$$\delta = (1 - y)^t, \quad (8)$$

where y is the average annual rate of reduction of production costs; t is the year of production of output. As for the accounting, in the prices, of the second type of obsolescence, it must be admitted that such a method has not been found.

In the Methodology for Determining Wholesale Prices of New Output Destined for Technical-Production Use, it is recommended that the influence exerted by obsolescence be reflected by the use, in the formula for the upper limit of the price, of indicators pertaining to the service life of the base technology and the new technology (T_b , T_n), with a consideration of the obsolescence. Inasmuch as the level of the second type of obsolescence depends upon the effectiveness of the new technology that is arriving on the scene, in order to determine the planned price of the obsolete technology it is insufficient to have at one's disposal the value of the upper limit of the price (adjusted with a consideration of the obsolescence). With the aid of simply the upper price limit it is impossible to establish a concrete quantitative gauge of the influence that obsolescence exerts upon the level of the planned price during the various periods of its action.

When computing the wholesale price that corresponds to the periods of obsolescence and the state of being completely obsolete, it is necessary to use indicators of the effectiveness of the application of the base and the new technology which is necessary to replace the former. The accounting for the influence exerted by the second type of obsolescence upon the size of the wholesale price can be carried out, in our opinion, on the basis of the

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interrelationship between the price level and the indicator of the effectiveness of the technology in the sphere of its application. For this purpose let us imagine the development of technology as a completely regular process in the growth of the effectiveness of each subsequent (replacing) type, the use of which assures the growth of the indicator of effectiveness in the sphere of application, for example, from the normative level (Y_{en}) to the level that provides an incentive for the consumer (R_g).

Considering the fact that the gauge of the second type of obsolescence is the proportion of the lost part of the value as a result of the relative fall in the effectiveness of the technology being used, let us express the influence that this process exerts upon the wholesale price as follows. Let us determine how the price of the old technology should change in order for its application to be equal in effectiveness to the new technology. For this purpose the price of the old technology must be adjusted by a coefficient that indicates the necessary degree of decrease in the price for the conditional attainment by the old technology of the level that corresponds to the effectiveness of the application of the new technology.

The indicator that corresponds to this requirement is the indicator of the correlation of the integral coefficients of replaceability -- V' (4), since it is precisely that indicator which provides the possibility of determining the necessary degree of price reduction in order to assure an increase in the effectiveness of application from the normative level (Y_{en}) to the level R_g . The reduction of the price of old technology in proportion to coefficient V' will make it possible to neutralize the negative influence of the second type of obsolescence upon the level of effectiveness (profitability) of the sphere of application.

However, one cannot avoid taking into account the levels of of profitability of that technology both in the sphere of application and in the sphere of production. A profitability level that is increased as compared with the normative level ($R_2 > R_n$) in the sphere of production is the result of including in the price part of the economic benefit obtained in the sphere of application. Putting it another way, the level of the effectiveness of the new technology is reflected in the total change of the indicators of profitability in the spheres of production and application. Therefore, for the conditional achievement by the old technology of the effectiveness level guaranteed by the new technology, the expenditures (price) of the base technology should be adjusted by using the overall coefficient for the reduction of expenditures (price) V (formula 7).

That coefficient is based upon the comparison of the effectiveness of the

old and the new technology in production $\frac{1 + R_n}{1 + R_2}$ and application $\frac{\alpha_{1s}}{\alpha_1 \text{ maks}}$.

Quantitatively, it corresponds to the required reduction in the wholesale

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price of the old technology for the conditional achievement by it of the level of effectiveness of the new technology. With the aid of this coefficient one can determine the degree of the second type of obsolescence (I_m) in percentages:

$$H_m = \left[1 - \frac{u_{nc}}{u_{n \text{ min}}} \cdot \frac{(1 + P_n)}{(1 + P_2)} \right] \cdot 100. \quad (9)$$

The level of obsolescence (I_m) indicates the percentage of "excessive" (economically unjustified) expenditures in the production of the old technology and can be viewed as the percentage of the part of the value lost by the old technology as a result of the appearance of the new and highly effective technology, that is, as a result of the operation of the second type of obsolescence.

Thus, the gauge of the second type of obsolescence is determined in respect to the value of the old technology, proceeding from the relative growth of the effectiveness of the new technology. In order to compute the planned amount of obsolescence of the individual types of output without waiting to receive the specific characteristics of the effectiveness of the new technology, one can take advantage of the tendency of the correlations between the indicators of the effectiveness of the base type of technology and the new type. This is possible, in our opinion, if one proceeds from the hypothesis that each subsequent type of technology must guarantee indicators of effectiveness in the sphere of application no lower than level R_g , and, in production, R_2 .

As for the indicators of the effectiveness of the type of technology that is being replaced, in this instance one can also abstract from the specific figures and assume that they are equal to Y_{e_n} for the sphere of application and R_n for the sphere of production. It is precisely these levels that are taken into consideration when determining the upper and lower price limits; and, in addition, when evaluating the level of effectiveness of the new technology, for purposes of comparison one usually uses the normative coefficient of effectiveness. This is equivalent to stating that the achieved indicator of effectiveness of the technology being used is taken as being at the level of the normative indicator.

At first glance it may seem that this approach contradicts the premise advanced by us, that the level of obsolescence depends upon the effectiveness of the technology that is going to replace that which is currently being used. However, this is not so, inasmuch we are not retreating from the principle proposed by us; instead, we are seeking the opportunity to realize it for the specific task of price determination. This task is complicated by the fact that the deadlines for the determination of the wholesale prices of new output (including the prices that correspond to the period of obsolescence) occur ahead of the deadlines for the obtaining of factual information concerning the level of effectiveness (both of the type being considered and of the

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type that will be replacing it). Therefore, in order to forecast the price level with a consideration of the influence exerted by obsolescence, we consider it possible and desirable to make use of the tendencies in the correlations of the effectiveness of the base type and the new type of technology. In the instance that we have at our disposal other indicators of the effectiveness of the technology types being compared, other than the indicators included by us in the overall coefficient for the lowering of price -- V (7) and the indicator of obsolescence -- I_m (9), it will be possible, when computing these values, to introduce the appropriate adjustments.

The proposed approach for the determination of the indicator of obsolescence (9) makes it possible, in our opinion, to give its computation a relatively stable nature, to view this indicator as a quantitative gauge of the part of the value that is lost by the technology as a result of the operation of the second type of obsolescence, and to forecast its level. The computation of this indicator, we assume, can be executed at any stage of the life cycle of the new technology (planning, assimilation, operation). The computations made in conformity with this formula for the group of machine-building output have shown that the planned level of obsolescence varies from 12 to 30 percent and, on the average, constitutes 20 percent.

As was already noted, the planned level of obsolescence (9) can be used for computing the level of the price that corresponds to the period of obsolescence. Inasmuch as, in this price level it is necessary to take into consideration the influence of the first and second types of obsolescence and formula (9) has reflected only the level of the second type of obsolescence, it is necessary to use, in addition to indicator I_m , the coefficient for price reduction under the influence of the obsolescence of the first type -- δ (8). The planned price level with a consideration of obsolescence Ts_{pl}^m will be:

$$U_{nn}^* = U_{nn} \cdot \left(1 - \frac{H_n}{100}\right) \cdot \delta; \quad (10)$$

where Ts_{pl} is the planned price that is in effect until the reflection of the obsolescence⁷.

Computations of the planned price level with a consideration of obsolescence Ts_{pl}^m in conformity with the previously cited formula (10) indicate that, in order to reflect the influence exerted by obsolescence upon price, it is frequently insufficient to regulate only the level of profitability of output. For example, when the coefficient for the price reduction (δ) is equal to 0.86 (computed with average annual rates of reduction of production costs $y = 0.03$, and output period $t = 5$) and a planned level of obsolescence (I_m) equal to 20 percent, the lowering of the price as a result of the reflection of the action of obsolescence will be 32 percent.

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The determination of the price level with a consideration of obsolescence T_{pl}^m should be made at the moment of assimilation of the production of the new type of technology, simultaneously with the computation of the planned price of the technical in the first period of its production and application. This will make it possible to plan both the dynamics of the wholesale price and the optimal periods for the production of the technology. The increase in the effectiveness of the basic trends in in scientific-technical progress is inseparably linked with assuring the prompt renewability of the output being produced in the machine-building branches.

FOOTNOTES

1. The question of price functions has been discussed in more detail on the pages of this magazine (see A. Koshuta, L. Rozenova, "Price Functions Under Conditions of Scientific-Technical Progress," VOPROSY EKONOMIKI, No 3, 1977).
2. See D. S. L'vov, "Ekonomika kachestva produktsii" [The Economics of Output Quality], Izdatel'stvo Ekonomika, 1972, p 105.
3. See "Metodika opredeleniya optovykh tsen na novuyu produktsiyu proizvodstvenno-tekhnicheskogo naznacheniya" [Methodology for Determining the Wholesale Prices of New Output Destined for Technical and Production Use], Preyskurantizdat, 1974, p 18.
4. The maximum admissible level of expenditures (Z_{maks}) for new technology (from the point of view of the economic desirability of its creation and introduction) means, in our opinion, that level of expenditures which assures the normative effectiveness of the new technology in production (R_n) and application (Ye_n) and can be expressed as

$$Z_{maks} = \frac{T_{s_{vp}}}{1 + R_n}.$$
5. See A. A. Koshuta, L. I. Rozenova, "Kachestvo i tseny produktsii mashinostroyeniya" [Quality and Prices of Machine-Building Output], Izdatel'stvo Mashinostroyeniye, 1976, p 72.
6. See Ibid., pp 199-201.
7. The following price structure is proposed: $S \cdot (1 + R_n)$. In the event that the price structure that is in effect until the moment of reflecting the influence exerted by obsolescence is different, the coefficients δ and I_m should pertain only to the production costs, and the amount of profit should be determined separately.

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REVIEW OF BOOK ON SCIENTIFIC-TECHNICAL PROGRESS

Moscow VOPROSY EKONOMIKI in Russian No 6, Jun 79 pp 143-145

[Review by V. Senchagov of the book "Effektivnost' nauchno-tekhnicheskogo progressa (Voprosy upravleniya)" [Effectiveness of Scientific-Technical Progress (Problems of Management)], responsible editor--corresponding member AS USSR L.M. Gatovskiy, Izdatel'stvo "Nauka", 1978, 327 pages]

[Text] One of the characteristic features of the development of economic sciences under the conditions of the scientific-technical revolution should be considered to be the appearance of a new scientific direction--the economics of scientific-technical progress. In this connection, the reviewed monograph,¹ encompassing a broad range of problems of management of scientific-technical progress, is of undoubted interest.

The basic objective of the book is to disclose the content of the category of national-economic social-economic effect of new equipment, methods of its attainment in self-financing results of complex management of the effectiveness of scientific-technical development.

The monograph opens with an investigation of the political-economic aspect of the category of national-economic social-economic effectiveness of new equipment and with the application of the methodology of its analysis as a most important object of control over scientific-technical progress. The complex character of this category is due to the interaction of objective economic laws of socialism, first of all of basic law, of the laws of economy of socialized labor and of the planned and proportional development of the national economy. For disclosure of the nature of the problem in the work, the position is based on the dual character of the category of national-economic effectiveness: as an aim of production--growth of the social-economic socially useful result and as the means of its attainment--economy of expenditures computed for the assigned socially useful result. At the same time, the author of this chapter proceeds from the well-known thesis of the classical

1. Authors' collective (according to chapters). L.M. Gatovskiy, M.A. Vilenskiy, A.S. Bystrov, Yu.A. Zykov, V.P. Loginov, V.G. Fel'zenbaum, T.L. Sletova, G.A. Lakhtin, V.G. Pankrat'yev, P.A. Sedlov, G.M. Glagoleva, K.I. Taksir, O.B. Popova, G.A. Tsaritsina, K.P. Kadrova, A.Sh. Akhmeduyev and L.I. Myrina.

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writers of Marxism-Leninism to the effect that in a future society problems of creation and distribution of resources will be solved through a comparison of useful effects of different items of consumption with each other and with the amount of labor required for their production.²

The monograph provides interest in the analysis made of the growth factors of the national-economic effect of new equipment, determination of the "effect of complexity" in the orientation of management of scientific-technical progress toward end results, classification of equipment and determination of the temporary boundaries of new equipment in connection with the criterion of the national-economic effect. A detailed examination is made of the correlations to be found between technical newness of equipment, its effect and obsolescence.

Special attention is devoted in the book to methods of quantitative evaluation of the influence of those social factors that are subject to economic measurement and can be adequately calculated in economic indicators. It is proposed to assess the possible negative consequences of scientific-technical progress for the state of man's health and the quality of the production and natural environment on the basis sanitary-hygienic, medical, ecological and other norms. In this connection the authors show how to overcome the negative consequences of scientific-technical progress, what changes are required for the solution of this problem in planning of development, building, introduction and adoption of new equipment.

It should be pointed out, however, that in the work the question is practically ignored of the economic mechanism of providing for and stimulating a rise in the social results of the new equipment, which is of scientific and practical importance. Here the social results of scientific-technical progress are studied only in regard to improvement of conditions of labor and conservation of the natural environment.

The monograph substantiates certain new approaches to the assessment of economic effectiveness of new equipment. In particular, it formulates proposals for the accounting of outlays for different time intervals and describes methods of calculating the dynamic values of the norm of efficiency of capital investments.

For ensuring correspondence of the functioning economic mechanism and the problems of acceleration of scientific-technical progress, the problem described in the book of determination of the self-financing (planned and actual) effect of new equipment as a reflection of its national-economic effect is of principal significance. The indicator of net profit and its increase are proposed to be used as an indicator of the self-financing effect. The introduction of the self-financing effect into a list of planned indicators makes it possible to tie in the plan of an enterprise and of the association for new equipment with other sections of the technical industrial financial plan.

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At the same time, insufficient attention is paid in the work to the methodological aspects of determining the actual self-financing effect, the directions of improving at enterprises the calculations of outlays for new equipment and their reflection in statistical and accounting reporting. Without a detailed analysis of these matters and ways of their solution, the proposals substantiated in the monograph for determination of the self-financing effect could not be exhaustive. We also consider disputable and inadequate the thesis argued in the book that the self-financing effect for the manufacturer of equipment is expressed in an abstract magnitude of net profit and for the consumer--in its growth.

Important original features put forth in the book include an analysis of the nature and forms of integration of science and production brought about by the scientific-technical revolution, a description of scientific-production cycles (research--technical development--production and use of new equipment). This is the basis for the formulation in the monograph of practical proposals on improving management of scientific-technical progress, especially with respect to economic substantiation and realization of a unified scientific-technical policy and the transition to a system of "through" planning, financing and stimulation of all parts of the scientific-production cycle.

In this connection, a detailed examination is made of the methods of ensuring an organic combination of management of scientific-technical progress and general economic management and a transition to unified comprehensive plans of scientific-technical progress as the initial and leading sections of general economic plans. We might point out here that the book does not sufficiently elucidate methodological questions of reorientation of annual and five-year technical industrial financial plans of production associations and enterprises for a fuller consideration of the possibilities and tendencies of scientific-technical progress.

The book examines in sufficient detail methodological and organizational questions of program goal planning; complex programs of scientific-technical development are described, and the effectiveness of the program method of is disclosed, with the necessary conditions for its achievement being formulated. A special feature of the use of the program goal method in planning is the use of the aggregate of complex programs, serving as the basis for the realization of a single scientific-technical policy. The book shows the chief directions in the development of a system for such programs (raising the technical-economic level of production and manufactured products, dynamics of the structure of material production and economic changes are evaluated with a system of program indicators), and the necessity is proved for going over to unified programs that take in the whole scientific-production cycle. In this connection a plan is proposed for calculating the material, labor and financial resources needed for carrying out programs and the organizational-economic mechanism of managing programs is elucidated.

More place should have been given in the monograph, however, to questions of interaction of plan and programs both from the point of view of the time of their compilation and of the determination of indicators of effectiveness of

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expenditures on the creation and adoption of scientific-technical innovations. What sort of correlation of plan and program exists, how the compilation of complex programs is organizationally incorporated in the content of plan work and what the program introduces that is concretely new into the methodology of determining the effectiveness of scientific-technical progress--all these questions inevitably arise in an assessment of the possibilities and prospects of development of the program-goal method of planning. But the authors unfortunately do not provide an exhaustive answer to them.

A characteristic feature of the monograph is the investigation of almost all questions raised in connection with scientific-production cycles. It examines critically the special features of the new system of planning, financing and economic stimulation of work on new equipment, which was used for the first time in the electrical equipment industry and is spreading widely to other sections of industry. The authors analyze this system in detail, pointing out both its positive features and its deficiencies. The book contains a number of conclusions and recommendations on through planning of scientific-technical progress (from research to serious production of products).

The authors propose the use of "through" indicators in the system of stimulation of scientific-technical progress. Among them, the main role is assigned to the economic effect obtained from the use of new equipment. The idea of the work--planning of end results of scientific-technical planning--is correct, but in this connection the system and methodology of using indicators of stimulation of scientific-technical development should have been shown in greater detail and with more concreteness.

The new procedure of financing scientific-research and experimental design work and work on the development of new equipment through a Unified Fund of Development of Science and Technology, formed from profits, has activated to some degree the work of scientific-research institutes and design bureaus. But it also has certain defects. Thus, the authors emphasize that during the period of experimental verification of this procedure the share of funds allocated for the development of new equipment was reduced and the volume of unfinished scientific-research work grew. The authors recommend a change in the manner of financing technical progress from the Unified Fund of Development of Science and Technology, which provides ensuring such a correlation between the volumes of scientific-research work, experimental-design work and work of putting into operation as would ensure a normal technical development of a sector.

The monograph examines in detail norms of expenditures for putting new items into production. But this problem is elucidated in insufficient detail--the main ways and methods of developing such norms in particular. In an analysis of certification processes of products on the basis of three categories of quality, the authors show that while the sum of additions to wholesale prices in connection with the conferring of the Seal of Quality has increased significantly, wholesale-price reductions are extremely rare. For this reason they propose changing the manner of determining reductions and increasing responsibility for the output of products of the second category of quality. Together

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with this, it is necessary, in our view, to improve methods of determining additions to wholesale prices. At the present time, these increases do not create for producers of new products stable stimuli for the development and adoption of new equipment, since they do not reflect in sufficient degree the national-economic effect of new equipment. In the final analysis, this results in a condition where the profitability of new equipment does not orient collectives of enterprises toward acceleration of scientific-technical progress.

The critical analysis of the experience of implementation at the present time of the transition of sectors of industry to new methods of management of scientific-technical progress permitted the authors to bring up the question of improving methods of formation of sectorial funds for the financing of scientific-technical progress (fund for the development of new equipment, Single Fund for Development of Science and Technology). The method they propose provides benefits for enterprises successfully adopting new equipment. In distinction to the procedure presently in use, it is recommended that deductions are made for technical development from two sources: production cost (according to stable norms) and profit (according to a progressively growing scale, depending on the level of newness and quality of a product). Such a procedure should contribute to speeding up renewal of products and to "shift" a part of the expenditures of manufacturers of new equipment to enterprises putting out obsolete products.

In connection with a certain sectorial decentralization of financial resources intended for acceleration of scientific-technical progress, the question of methods of financial provision of intersectorial national-economic programs of scientific-technical development is achieving major importance. Here, the authors write, different approaches are possible: budgetary financing, creation of intersectorial (program) funds of scientific-technical progress and so on.

The monograph points out deficiencies in the existing system of payment of bonuses to personnel of enterprises and organizations for the creation and adoption of new equipment and proposes measures aimed at strengthening the stimulating influence of material rewards. Special attention in this is given to the mechanism of distribution of bonus funds among personnel. Of major value for heightening material interest is the objective assessment of the contribution of each staff worker to the fulfillment of the general scientific-technical task. The authors substantiate methodological recommendations for the distribution of the total sum for new equipment among the participants of the work in fulfillment of concrete themes and measures.

Thus the results of an important stage in the investigation of problems of effectiveness of scientific-technical progress are generalized in the book. It would have been desirable if the authors, on the basis of the methodology they developed for determination of national-economic and self-financing

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effectiveness of scientific-technical progress, had gone on to a broader analysis of the actual effectiveness of its most important directions. Such an analysis would have helped to rank scientific-technical measures according to the degree of their effectiveness and on this basis to develop scientific foundations for the determination of priorities in distribution of resources according to individual directions of scientific-technical progress.

The monograph makes a contribution to the theory and practice of management of scientific-technical progress.

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CONFERENCE ON MANAGEMENT INNOVATIONS, EXPERIMENTS

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[Report by I. Vasil'yev: "Management Innovations and the Economic Experiment"]

[Text] The successful solution of tasks set by the 25th CPSU Congress for improving the forms and methods of management requires use of scientifically based methods in the development and adoption of management innovations. An innovation is a long and complex process involving research, development, experimentation, training of cadres and so on. At the first scientific-practical conference "Problems of Management Innovations and Economic Experimentation" held in Tallin in December 1978 there were discussed theoretical, methodological and method questions of experimentation, legal, organizational and other aspects of the economic experiment. The organizers of the conference were the Public Committee on Problems of Management of the NTO [Scientific-Technical Society (?)] of Estonia, the Section of Organization Sociology of the Soviet Sociological Association, the Intersectorial Institute for Raising the Qualifications of Managers and Specialists of the National Economy of the USSR and the Estonian Scientific-Research Institute of Scientific-Technical Information and Technical-Economic Research. About 150 economists, sociologists and psychologists took part in the conference; they were representatives of Moscow, Tallin, Leningrad, Riga, Perm' and other cities.

Following the opening remarks of deputy chairman of Gosplan of Estonian SSR E. Rozenberg, reports were presented by N. Lapin (Moscow)--"Theoretical Bases of Innovation and the Economic Experiment," Yu. Vooglayd (Tallin)--"Methodological Problems of Innovation and Economic Experimentation," L. Savel'yev (Tallin)--"Methodical and Practical Problems of Innovation" and A. Reyner (Tallin)--"Methodical and Practical Problems of Economic Experimentation." Then the problems were discussed in discussion groups.

Participants of the group "The Nature and Structure of the Economic Experiment" (leader--G. Kiperman from Moscow) unanimously defined the economic experiment as a scientifically arranged experiment (conducted under real production and social conditions) for verifying the reliability of this or that hypothesis, determining the feasibility, practical possibility and conditions of introducing into practice the innovation. In the course of the discussion the importance of careful preparation of an experiment. The experiment must be preceded by theoretical substantiation of the proposed innovation--economic-mathematical modeling, exclusion of obviously unapplicable versions,

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a thorough consideration of economic, social, when necessary, demographic, ecological and other aspects of the problem. T. Novikova (Moscow) directed attention to the need for providing representativeness of the items selected for the experiment and the presence of a control group. The last-named requirement elicited the comment: the presence of a control group is a desirable but not a necessary condition for conducting an experiment. The question was also discussed as to whether an experiment would be necessary if its positive results are predetermined. Evidently it would be necessary, and the purpose of conducting it in such a case is to determine the conditions of most effective utilization of the proposed innovation and to refine the methodology prior to its wide-scale use.

Many questionable and unresolved problems exist in the methodology of measuring the effectiveness of innovations, and the actual procedure of determining the factors, sources and types of result is most laborious. These problems were discussed in the discussion group "Problems of Effectiveness of the Innovative Process" (leader--Yu. Kelin from Tallin). Under conditions of limitation of resources, including labor resources, in the opinion of Yu. Kelin the criterion of effectiveness of the innovative process has to reflect recovery of outlays made in carrying it out. An innovation may be considered effective only in the case where it contributes to the attainment of a national-economic goal--all-round satisfaction of the requirements of all the people. I. Zhezhko (Moscow) emphasized the major significance of participation of the organization, serving as the testing ground (object of improvement) of the given introduction at all stages of the innovative activity. In practice, personnel of an enterprise are included in the development of an innovation only at the concluding stage--of putting it into operation; as a result, intraorganizational reserves and key elements of management not only do not contribute to the successful introduction of an innovation but frequently block it. V. Rat'kovskiy (Saratov) spoke of the need for taking into account the social factor in the introduction of an innovation. V. Pavlyuchenko (Moscow) noted that one of the chief directions of improvement of planning of economic experimentation is the consistent use of the systems approach in his organization. This proposes switching from the carrying out of separate, usually weakly interrelated experiments aimed at a partial improvement of management to the adoption of a system (or a number of programs) of interconnected ones aimed at a comprehensive working out of big, key problems relating to the improvement of the mechanism of management. Such for example, could be programs of experiments on working out of methods of implementation of national-economic programs, creation of an effective mechanism for overcoming departmental barriers and increased orientation of related parts of production for the achievement of end results.

Discussions were also held at the conference on the topics: "Factors Contributing to and Hindering the Introduction of Innovations, the Necessary Prerequisites of Economic Experimentation" (leader--A. Prigozhin from Moscow), "Methodological Equipment of the Economic Experiment" (leader--V. Pavlyuchenko from Moscow), "Training of Specialists for Innovation and Economic Experimentation" (leader--M. Khabakuk--Tallin) and others.

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The conference participants reached the unanimous opinion that economic experimentation should be an organic part of planned improvement of the economic mechanism of management of the national economy and an inseparable stage of processes of management innovations. The conference recommended development of work in this field along the following directions: expansion of scientific analysis and generalization of experience of economic experimentation and introduction of management innovations; perfecting of the theory and methodology of innovation and economic experimentation, as well as others.

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